

(12) UK Patent Application (19) GB (11) 2 229 242 (13) A

(43) Date of A publication 19.09.1990

(21) Application No 9004103.9

(22) Date of filing 23.02.1990

(30) Priority data

(31) 01031032
01058239

(32) 17.03.1989
19.05.1989

(33) JP

(71) Applicant
Kyodo Electric Co Ltd

(Incorporated in Japan)

24-12 Higashi 3-chome, Shibuya-ku, Tokyo, Japan

(72) Inventors

Minoru Yoshida
Teruo Arai
Toshiro Ishikawa
Masaji Shimada
Shigeru Susaki
Yukihiko Yamada
Hisao Ohta
Katsuyoshi Nagami
Kazutami Hayajiri
Takaharu Yoshioka

(51) INT CL³

F16B 31/02

(52) UK CL (Edition K)

F2H HTD H15A H15E H15F H15G H15K
G1W WE7A
U1S S2055

(56) Documents cited

None

(58) Field of search

UK CL (Edition J) F2H HTD, G1W
INT CL⁴ F16B 31/02
Online databases: WPI

Singo Hirai
Tosio Ichida
Nobuyuki Ishii

(74) Agent and/or Address for Service

Beresford & Co
2-5 Warwick Court, High Holborn, London WC1R 5DJ,
United Kingdom

(54) Apparatus for indicating completion of fastening of screw components

(57) A tightness indicator for a screw-threaded assembly (1, 2) comprises a washer (3) consisting of a pair of confronting apertured discs (3A, 3B) joined by a bridge (3C), and a deformable ring (5) located between the discs (3A, 3B) and larger in diameter than them, so that when the deformable ring (5) is compressed by the discs (3A, 3B) as the assembly is tightened, its outer part breaks away when the compression force reaches a predetermined value.

FIG. 3

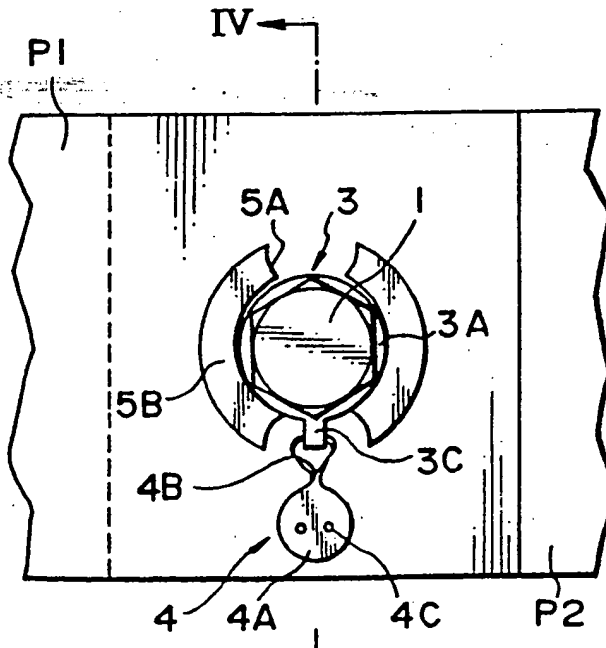


FIG. 4

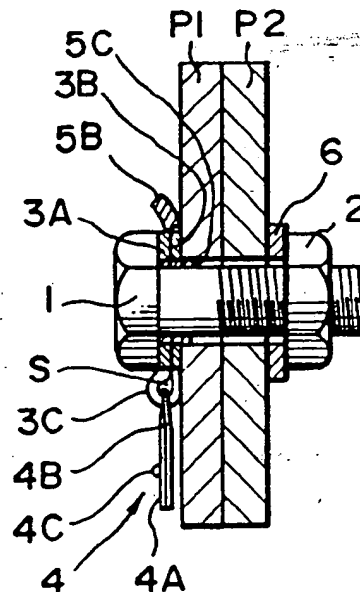


FIG. 1

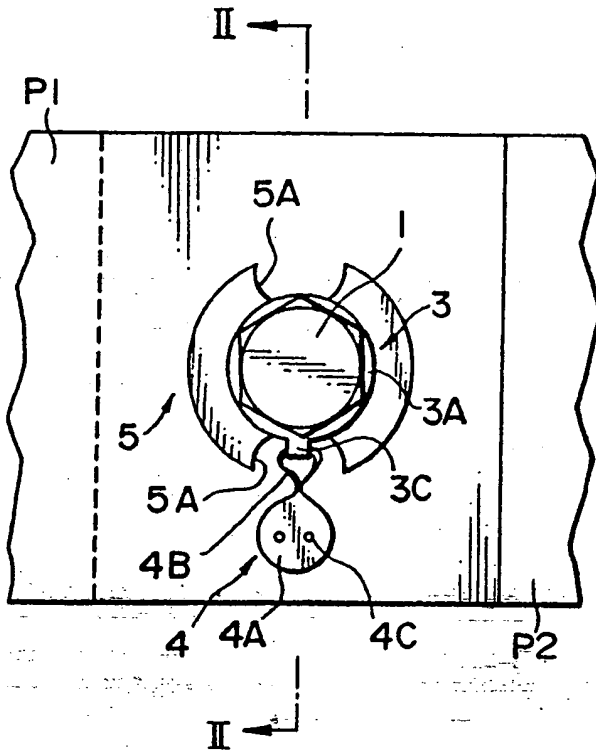


FIG. 2

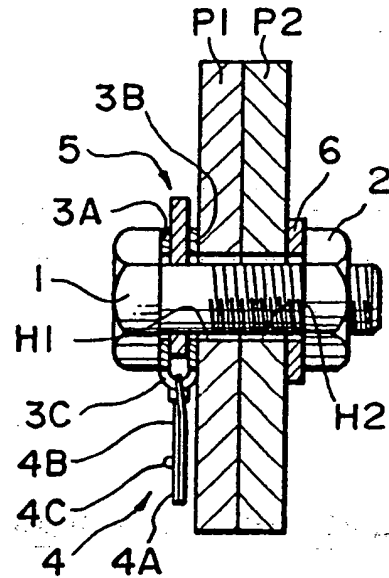


FIG. 3

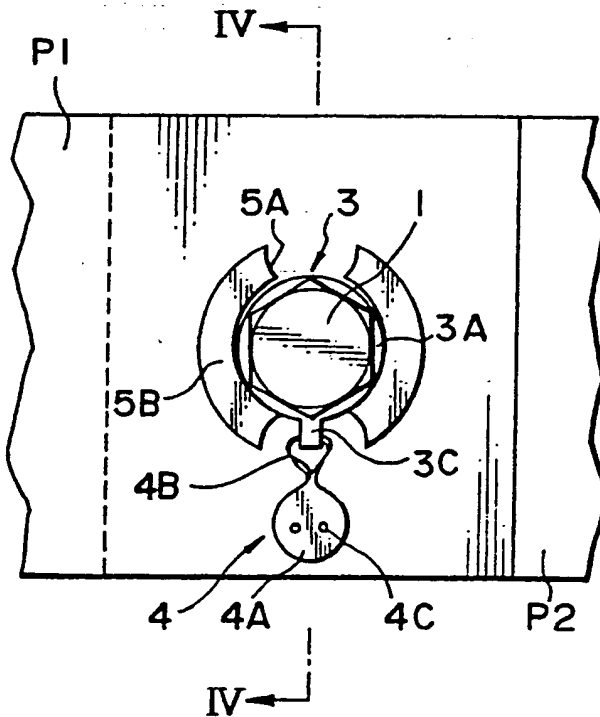
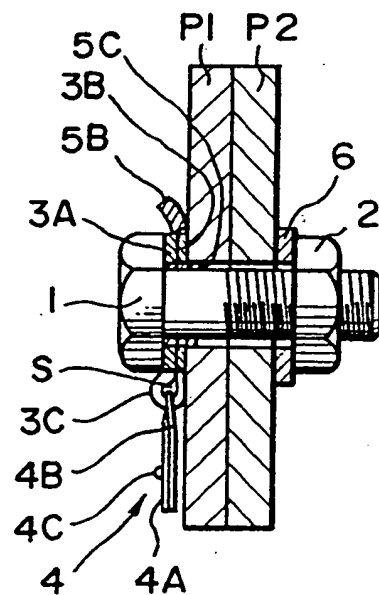


FIG. 4



2/6

FIG. 5A

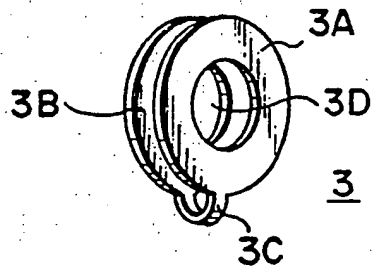


FIG. 5B

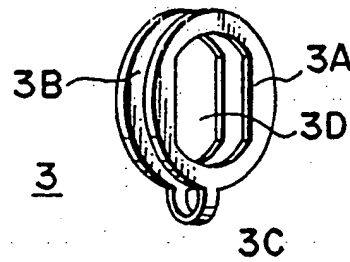


FIG. 6

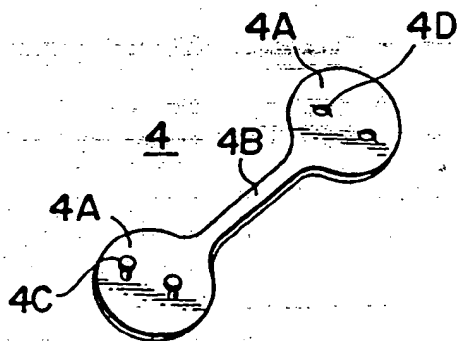


FIG. 7

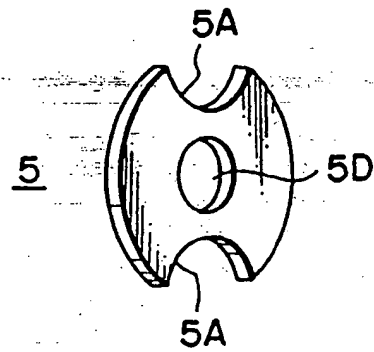
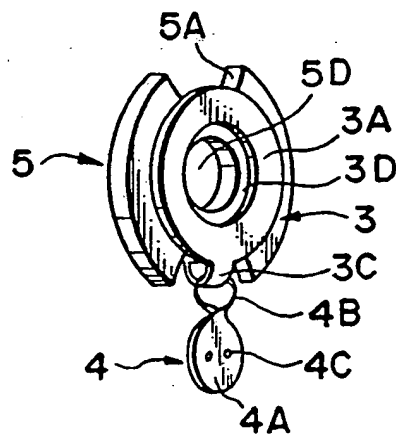


FIG. 8



3/6

FIG. 9

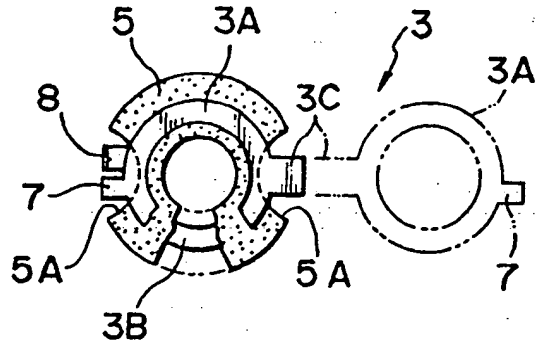


FIG. 10

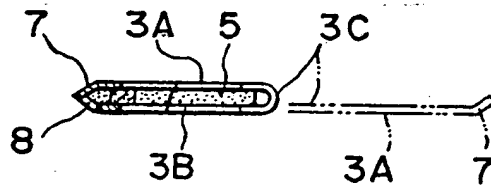
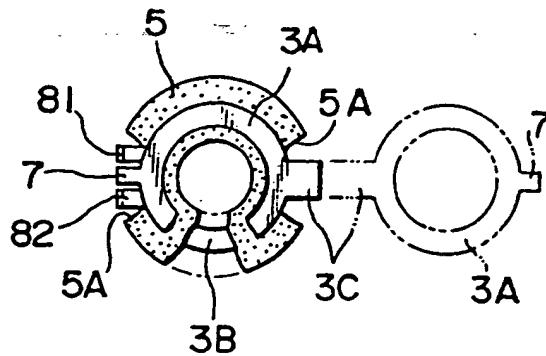


FIG. 11



4/6

FIG. 12

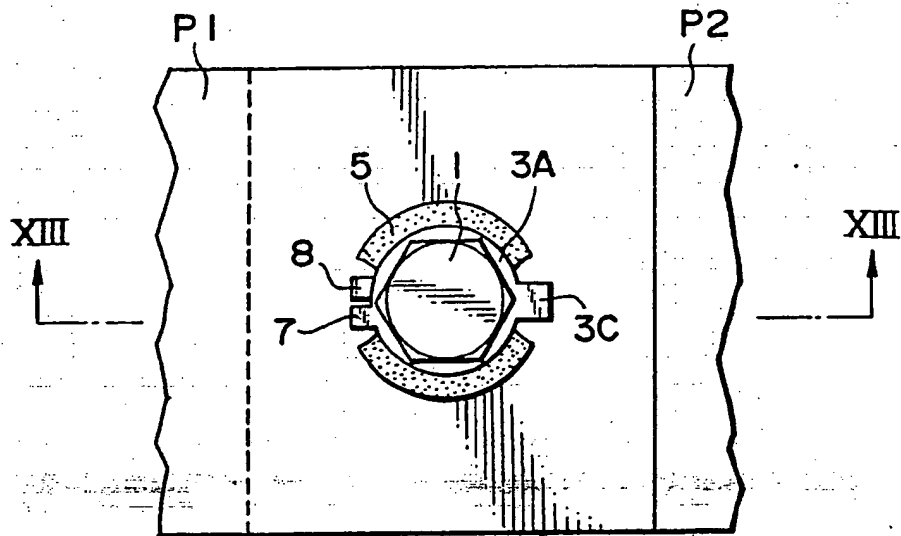
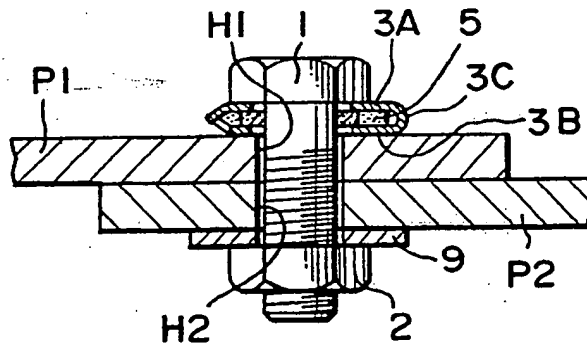


FIG. 13



5/6

FIG. 14

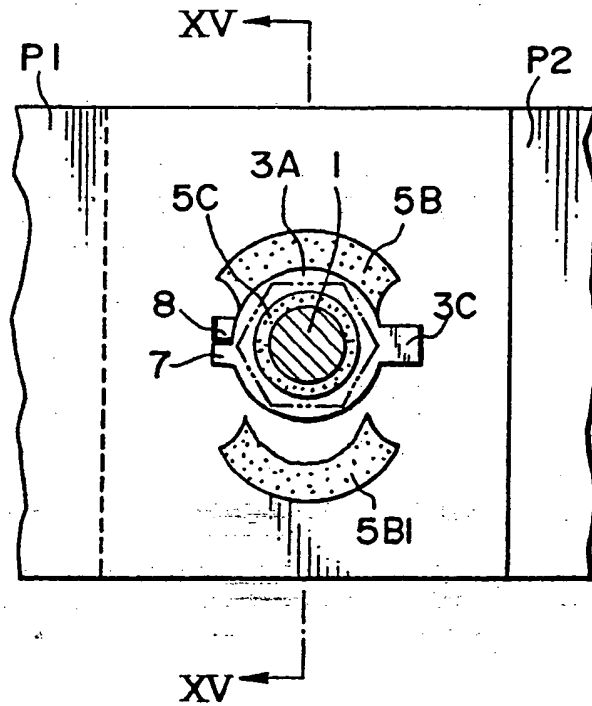
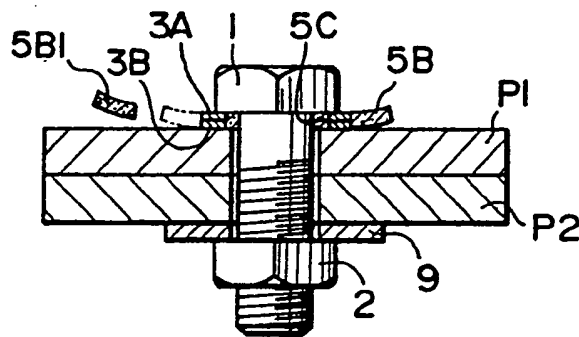


FIG. 15



6/6

FIG. 16

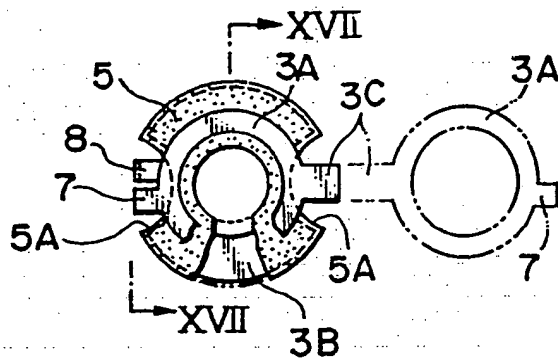


FIG. 17

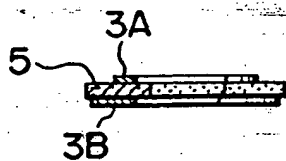
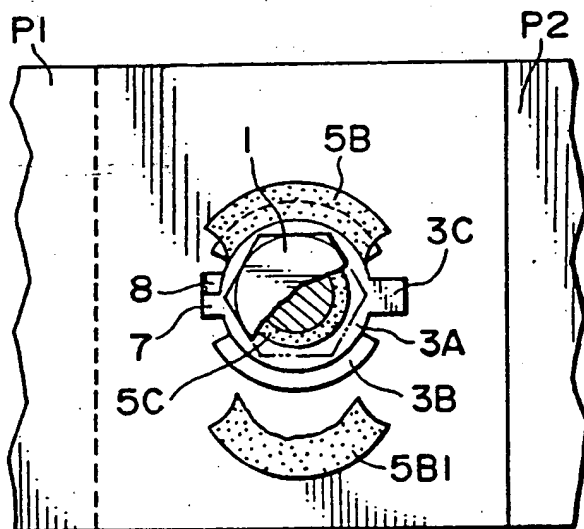


FIG. 18



1 APPARATUS FOR INDICATING IMCOMPLETE AND COMPLETE
FASTENING OF SCREW COMPONENTS

5 BACKGROUND OF INVENTION

Field of the Invention

The present invention relates to an apparatus for indicating whether the screw components, such as bolts and nuts, are fastened incompletely or completely.

10 Description of the Prior Art

Connecting work of electric conductors, assembling work of equipment, construction work, and other works are often accompanied with fastening work using bolts and nuts. In those works, bolts and nuts left unfastened due to carelessness of workers and rough work, or insufficiently fastened due to negligence for a long time after temporary fastening with bare hands may develop critical failure. In order to eliminate such failure, the following prior art has been proposed.

20 In the Japanese utility model publication No. 28992/1973, for example, there is disclosed a bolt assembly which has a fastener head. The fastener head has a stress concentrating portion in the axial extension (longitudinal direction) of a bolt which has been mounted on the bolt head through the stress concentrating portion in a detachable manner. When the bolt is screwed by the fastener head with a tool and attained the predetermined torque, the stress concentrating portion is destroyed to separate the fastener head. Incompleteness and completeness of fastening are indicated by whether or not the fastener head exists on the bolt head.

30 Also, in the Japanese utility model publication No. 44830/1976, there is disclosed a twin headed member having a stress concentrating portion formed by providing cuts from the perimeter on the middle part of the axial extension. When one head of the twin headed member is fitted in the bolt head and the bolt is rotated by the other head with a tool, the stress concentrating portion is

1 broken at the predetermined torque.

In both structures of the prior art, however, since a head to be first rotated with a tool and a stress concentrating portion to be broken at the predetermined torque are positioned on the axial extension of the bolt, the height of the bolt head increases toward the axial extension of the bolt at least by the sum of each height of the head to be rotated with a tool and the stress concentrating portion, and as a result, space to be occupied with the bolt head increases. Consequently, in a working place where there is no space in the altitudinal direction of the bolt head, the structures of the prior art will cause such an inconvenience as impossibility of mounting bolts.

In addition, since those structures disclosed in the above-mentioned Japanese utility model publications have been invented only for application to bolts, the structures are not applicable to nuts.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide, for removing those inconveniences found in the prior art, an indicator capable of indicating incomplete and complete fastening of screw components and providing the fastened portion with sealability, using conventional bolts.

In accordance with the present invention, apparatus for indicating incomplete and complete fastening of screw components comprises a washer member consisting of a generally flat sheet of material which has a first opening of a size sufficient to receive the shank of the screw components as well as prevent said screw components from passing through said first opening, and a ring member consisting of a generally flat synthetic resin sheet of material which has a second opening of a size sufficient to receive the shank of said screw components as well as prevent said screw components from passing through said second opening. Said washer member comprises a pair of washers each of which has a generally flat, round external shape with an outside diameter at least equal to that of the screw components and has the first opening provided almost on the center thereof, and a joint portion which interconnects the pair of washers to

1 face them in opposite directions so that each of the first opening of the
washers can equally receive the shank of the screw components. The longitudinal
cross section of the joint portion which is substantially perpendicular in the
axial extension (longitudinal direction) of said shank forms generally a U-shape
5 when said washer member receives the screw components in the first opening.
The afore-mentioned ring member comprises a generally circular deformable
material and has been inserted into the pair of washers. The outside diameter of
said generally circular material is substantially larger than that of either
one of the pair of washers. Said deformable material is lengthened radially in
10 an outward direction, when it is compressed with the pair of washers after the
shank of the screw components is received in the first and second openings and
said screw components are fastened. When the compressive force reaches a
predetermined value, said ring member is destroyed due to overlapping of the
pair of washers.

15

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention will become more
apparent from the consideration of the following detailed description taken in
conjunction with the accompanying drawings in which:

20

FIG. 1 is a front view illustrating an embodiment of an apparatus for
indicating incomplete and complete fastening of screw components in accordance
with the present invention prior to fastening;

FIG. 2 is a lateral sectional view taken along alternate long and
short dash line II-II of FIG. 1;

25

FIG. 3 is a front view, similar to FIG. 1, illustrating the embodiment
shown in FIG. 1 after fastening has been completed;

FIG. 4 is a lateral sectional view taken along alternate long and
short dash line IV-IV of FIG. 3;

30 FIGS. 5A and 5B are perspective views illustrating washers to be used
for the embodiment shown in FIG. 1;

FIG. 6 is a perspective view illustrating an indicator member to be
used for the embodiment shown in FIG. 1;

FIG. 7 is a perspective view illustrating an elastic synthetic resin
ring to be used for the embodiment shown in FIG. 1;

1 FIG. 8 is a perspective view illustrating a ring which has been interposed between washers assembled with the indicator member;

 FIG. 9 is a front view illustrating an application of an assembly of the washers and the ring to be used for the embodiment;

5 FIG. 10 is a lateral view illustrating the assembly of the washers and the ring shown in FIG. 9;

 FIG. 11 is a view, similar to FIG. 9, illustrating an alternative application of the assembly of the washers and the ring;

10 FIG. 12 is a front view, similar to FIG. 1, illustrating the apparatus for indicating incomplete and complete fastening of screw components loaded with the assembly of the washers and the ring shown in FIG. 9 prior to fastening;

 FIG. 13 is a lateral sectional view taken along alternate long and short dash line XIII-XIII of FIG. 12;

15 FIG. 14 is a front view, similar to FIG. 12, illustrating the embodiment shown in FIG. 12 after fastening has been completed;

 FIG. 15 is a vertical sectional view taken along alternate long and short dash line XV-XV of FIG. 14;

20 FIG. 16 is a front view, similar to FIG. 9, illustrating a further alternative application of the assembly of the washers and the ring;

 FIG. 17 is a lateral sectional view taken along arrowed line XVII-XVII, illustrating the assembly of the washers and the ring; and

25 FIG. 18 is a front view, similar to FIG. 14, illustrating the embodiment of the apparatus for indicating incomplete and complete fastening of screw components loaded with the assembly of the washers and the ring shown in FIG. 16 after the fastening has been completed.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

30 Referring to FIGS. 1, 2, 3, and 4, there is shown an application of the present invention in the portion where two boards P1 and P2 are to be overlapped and fastened with a bolt and a nut. FIG. 1 is a front view illustrating the embodiment prior to fastening and FIG. 2 is the vertical sectional view of the embodiment where there are shown the boards P1 and P2 whose bolt through-holes H1 and H2 are coincided with each other and then

1 threaded with a bolt 1 on which a nut 2 is screwed. Washers 3 and an elastic
synthetic resin ring 5 are inserted between the bearing surface of the head
portion of the bolt 1 and one board P1, while a washer 6 is inserted between
the bearing surface of the nut 2 and the other board P2. The washers 3, as shown
5 in FIGS. 5A and 5B, the upper washer portion 3A and the lower washer portion 3B
of a pair of washers 3 are joined integrally with a joint portion 3C to form
the lateral section into a generally U shape. The elastic synthetic resin ring 5
is inserted into a space between the pair of washer portions 3A and 3B. The
joint portion 3C of the washers 3 has an indicator member 4, as shown in FIG. 6,
10 suspended thereon for confirmation of fastening.

Each diameter of the bolt through-holes H1 and H2 on the boards P1 and
P2 and the hole on the center of the washer 6 is slightly larger than the
outside diameter of a general bolt 1 to provide a gap between each hole and the
15 bolt 1. The washers 3 shown in FIG. 5A have generally round openings 3D of
slightly larger diameter on the upper washer portion 3A and the lower washer
portion 3B than the outside diameter of the bolt 1. The washers 3 shown in FIG.
5B have generally oval openings 3D. A part of each perimeter of the upper
washer portion 3A and the lower washer portion 3B of the washers 3 is joined
20 integrally with the joint 3C to form the lateral section into a generally U
shape. Each outside diameter of the upper washer portion 3A and the lower
washer portion 3B of the washers 3 is generally equal to or larger than that of
the head portion of the bolt 1. The joint portion 3C is projected out of the
bearing surface of the screw components. The indicator member 4 shown in FIG. 6
25 has generally round indicator boards 4A-4A integrally provided on both ends of
an engaging portion 4B to be engaged with the joint 3C of the washers 3. On one
indicator board 4A there are formed protrusions 4C, while on the other
indicator board 4B there are formed holes 4D. When the indicator member 4 is
mounted on the washers 3, the protrusions 4C are fitted in the holes 4D as shown
30 in FIG. 8.

Instead of the fitting means, alternative means, such as fasteners
having male and female surfaces, may be used. It is optional to use those
members made of either plastic or metal sheet in proper shape and size. In the

1 illustrative application, the indicator boards 4A-4A have been formed
integrally with the engaging portion 4B. However, those indicator boards may be
formed and fitted to the washers 3 as discrete members in a proper means. As
for the indicator member 4, it is desirable to use colored one for easy visual
5 confirmation.

In FIG. 7, there is shown an illustration of the elastic synthetic
resin ring 5 of which the outside diameter is larger than that of the upper
washer 3A of the washers 3 and the inside diameter is a size substantially fit
10 to the shank of the bolt 1. The suitable material for the ring 5 is, for
example, silicone rubber, while other synthetic resin materials that have
elasticity suitable for attainment of the objects of the present invention may
be used. As for the ring 5, it is desirable to use colored one for easy visual
confirmation. It is recommended to select a color for the ring 5 different from
15 the one for the indicator member 4.

To make it possible to break the elastic synthetic resin ring 5 when
the fastening pressure of the bolt 1 and the nut 2 reaches the predetermined
value, parameters, such as size and shape for the openings 3D provided on the
20 upper and lower washer portions 3A and 3B of the washers 3, should be properly
designed; or such materials which have elasticity desired for the ring 5 should
be selected, or the shape and thickness of the ring 5 should be properly
designed. In the illustration thereof, the ring 5 has generally radial cuts 5A
formed on a plurality of portions of the perimeter. The intensity of fastening
25 pressure required for breaking the ring 5 varies depending on the shape, number,
or depth of the cuts 5A. The cuts 5A may be formed on the internal perimeter or
both external and internal perimeters of the ring 5.

The assembly consisting of the washers 3 with the indicator member 4
30 and the ring 5 may be fitted in the shank of the bolt 1 as they are in a state
of being separated with each other. As shown in FIG. 8, to assemble the washers
3 integrally with the ring 5 beforehand by retaining the ring 5 inserted
between the upper and lower washer portions 3A and 3B of the washers 3 or
glueing ring 5 to either the upper washer portion 3A or the lower washer portion

1 3B makes it possible to stably position the ring 5 inwardly on the joint
portion 3C of the washers 3, since the indicator member 4 retains the position
of the ring 5, resulting in easy handling. When it is necessary to
discriminate the upper washer portion 3A from the lower washer portion 3B, it
5 is recommended to make a difference in outside diameter between the upper and
lower washer portions or select different colors for each other for further
convenience.

When the nut 2 is rotated to increase fastening under the state shown
10 in FIGS. 1 and 2, the upper washer portion 3A of the washers 3 is pressed
against the bearing surface of the head portion of the bolt 1 and subsequently
the portion, which has been interposed between the upper and lower washers 3A
and 3B of the washers 3, of the elastic synthetic resin ring 5 located inside
the washers 3 is compressed to be lengthened radially. When the fastening
15 pressure reaches the roughly predetermined value, the upper and lower plate
portions 3A and 3B of the washers 3 are brought almost in contact with each
other, leaving the joint portion 3C where the indicator member 4 has been
fitted. As a result, the compressed and fastened portion of the ring 5 is
broken inwardly and outwardly. Under the state of the ring 5 being broken as
20 shown in FIG. 3, an inward broken piece 5C of the ring 5 comes off between the
upper and lower washer portions 3A and 3B of the washers 3, and as a result, the
broken piece 5C makes inroads into a gap between the bolt 1 and the openings 3D
on the upper and lower washer portions 3A and 3B as shown in FIG. 5A and the
through-hole H1 of the workpiece P1.

25

Simultaneously, the outwardly broken piece 5B is a product produced
as the result that the portion of the ring 5 interposed between the upper and
lower washer portions 3A and 3B of the washers 3 is pushed out of the
overlapped portion of the upper and lower plate portions 3A and 3B of the
30 washers 3. More specifically, because the internal perimeter of the ring 5 is
lengthened, tensile stress is concentrated on the portion of the ring 5
narrowed by the cuts 5A to cause breakage as shown in FIG. 3. The outwardly
broken piece 5B can be easily removed with hands, since it comes to be in a
state of being hooked on the external perimeter of the overlapped portion of

1 the upper and lower washer portions 3A and 3B of the washers 3.

Under the above-mentioned state of fastening, as the joint portion 3C of the washers 3 is placed on the location protruded radially in an outward direction to the bearing surface of the head portion of the bolt 1, a gap S is formed inside the apex of the joint portion 3C as shown in FIG. 4. Consequently, the engaging portion 4B of the indicator member 4 fitted to the joint portion 3C maintains the initial condition of the indicator member 4 being first fitted thereto without receiving the fastening pressure.

In the above-mentioned illustrative embodiment of the present invention, fastening has been made by rotating the nut 2. However, in case that the head side of the bolt 1 is fastened by the nut 2 being held with a holding tool, the upper and lower washer portions 3A and 3B are fitted in the shank of the bolt 1 in a form being integrated with the joint portion 3C. Consequently, the friction resistance of the bearing surface of the head portion of the bolt 1 caused by a single rotation of the bolt 1 is not transmitted to the elastic synthetic resin ring 5 interposed between the upper and lower washer portions 3A and 3B. Thus, the ring 5 receives even distribution of the fastening pressure on the entire perimeter without being twisted and is broken at the predetermined fastening pressure.

Also in the illustrative embodiment, the assembly of the washers 3 with the indicator member 4 and the ring 5 is interposed under the bearing surface of the head portion of the bolt 1, while the assembly may also be interposed under the bearing surface of the nut 2 or under both bearing surfaces of the head portion of the bolt 1 and the nut 2.

Further, selection of shape and size for the openings 3D of the upper and lower washer portions 3A and 3B of the washers 3 makes it possible to adjust the size of the compressive area on the elastic synthetic resin ring 5 and preset the ring compression load required for breaking the ring 5 at the predetermined fastening pressure.

1 To sum up, in the illustrative embodiment, when the screw components
are fastened in a state of being equipped with the elastic synthetic resin ring
5 interposed between the upper and lower washer portions 3A and 3B of the
washers 3 that have a generally U-shaped lateral section and have been fitted
5 under the bearing surface of the head portion of the bolt 1, the portion of the
ring 5 interposed between the upper and lower plate portions 3A and 3B of the
washers 3 is compressed to be lengthened radially in outward and inward
directions. When the fastening pressure reaches the predetermined value, the
lengthening of the ring 5 reaches the limit at the same time when the upper and
10 lower washer portions 3A and 3B of the washers 3 overlap, and then the ring 5
is broken inwardly and outwardly by the upper and lower washer portions 3A and
3B. The inwardly broken piece 5C makes inroads into a gap between the shank of
the screw components and the washers 3 and blocks the inlet portion of the gap.
The outwardly broken piece 5B is torn off radially when the lengthening of the
15 internal perimeter reaches the limit at the same time when the ring 5 is pushed
out of the upper and lower washer portions 3A and 3B of the washer 3. The
outwardly broken piece 5B is then in a state of being hooked on the external
perimeter of the upper and lower washer portions 3A and 3B and can be removed
with the fingers.

20 As the joint portion 3C of the upper and lower washer portions 3A and
3B of the washers 3 has been protruded beyond the bearing surface of the screw
components, even when the upper and lower washer portions 3A and 3B overlap with
each other as the result of fastening the screw components, a gap on the apex
25 of the protruded joint portion 3C is left incompressible. As a result, the
indicator member 4 fitted to the joint portion 3C maintains the initial
condition of being fitted thereto without being broken. Consequently, a spot
where the elastic synthetic resin ring 5 has been broken and hooked on the
external perimeter of the upper and lower washer portions 3A and 3B as the
30 result of compressing the washers 3 which have a generally U-shaped lateral
section interposed under the bearing surface of the head portion of the screw
components and overlapping of the upper and lower washer portions 3A and 3B or
a spot where the indicator member 4 has been fitted thereto indicates completion
of fastening.

1 Still further, a spot where the upper and lower washer portions 3A
and 3B have not been overlapped due to failure of compressing the washers 3
interposed under the bearing surface of the head portion of the screw components
even when the indicator member 4 has been fitted thereto or a spot where the
5 elastic synthetic resin ring 5 has been left interposed between the upper and
lower washer portions 3A and 3B even when the upper and lower washer portions 3A
and 3B have overlapped with each other indicates insufficient fastening due to
negligence or temporary fastening.

10 In addition, a spot where the indicator member 4 has not been fitted
indicates a spot where the washers involved in the embodiment of the present
invention were not used and this spot will be a checkpoint for periodical
inspection.

15 Since an indicator for incomplete and complete fastening of screw
components of the illustrative embodiment has the afore-mentioned structure, in
the fastening work using screw components, for those screw components whose
washers having a generally U-shaped lateral section interposed under the
bearing surface of the head portion of the screw components have not been
20 compressed and the upper and lower washer portions have not been overlapped or
whose elastic synthetic resin ring has been left interposed between the upper
and lower plate portions of the washers even when the upper and lower washer
portions have been overlapped with each other, it is indicated that fastening
has not been completed or insufficiently made. The outside diameter of the ring
25 is larger than that of the head portion of the screw components for easy visual
confirmation.

 It is a simple matter to visually confirm that those screw components
whose upper and lower washer portions having a generally U-shaped lateral
30 section have been overlapped and whose elastic synthetic resin ring has been
broken or separated have been fastened properly and completely at the
predetermined pressure. When the screw components have been fastened at the
predetermined pressure, the inwardly broken piece of the elastic synthetic
resin ring has made inroads into a gap between the shank of the screw

1 components and the upper and lower washer portions, and as a result,
airtightness and/or watertightness of the fastened portion of the screw
components is maintained.

5 Because of the comparatively simple structure in which the washers
having a generally U-shaped lateral section are interposed under the bearing
surface of the head portion of the screw components which have the elastic
synthetic resin ring interposed between the upper and lower washer portions and
the indicator member fitted to the joint portion of the washers, a space in the
10 axial extension (longitudinal direction) is not excessively occupied by the
screw components. Thus, an apparatus for indicating incomplete and complete
fastening of screw components can be obtained at lower cost.

In an application where screw components comprise a bolt and a nut
15 and an elastic synthetic resin ring has been interposed between washers on the
bolt side, when the bolt is rotated to be fastened with a tool while holding
the nut with another tool to inhibit the relative rotation of the nut, the
elastic synthetic resin ring in a state of being interposed between the upper
and lower washer portions co-rotates with the bolt head. Consequently, the ring
20 can be broken at the predetermined pressure without being twisted and with even
distribution of fastening pressure on the entire perimeter.

In an application where washers with an elastic synthetic resin ring
interposed therein are mounted on the nut side and then the nut is rotated to be
25 fastened after the bolt is held so as not to be co-rotated, and in another
application where washers with an elastic synthetic resin ring interposed
therein are mounted on the pressure bolt, a similar effect can be obtained.
Consequently, as there is no need to especially provide any engaging means for
co-rotation of the elastic synthetic resin ring and the washers on the bearing
30 surfaces of the bolt or the nut, the present invention may be applicable to
conventional bolts and nuts.

FIGS. 9 - 14 illustrate an alternative embodiment of the present
invention. FIG. 9 is a front view illustrating an elastic synthetic resin ring

1 having washers on both sides. FIG. 10 shows the lateral view of the elastic
synthetic resin ring 5 with the washers 3 overlapped on both surface and back.
In the figures, similar components or structural elements are designated by the
same reference numerals, and redundant description will be avoided for
5 simplicity.

In the illustrative embodiment of the present invention, the washers
3 have been formed integrally as a solid component. This solid assembly of a
pair of washer portions 3A and 3B is used for the purpose of preventing both
10 washer portions 3A and 3B from slipping out of the symmetrical position due to
friction caused by fastening the bolt 1 and the nut 2. The present invention
will not be confined to the integrally assembled structure. In the illustration,
however, the washers are made of sheet steel stamped out into a form of a pair
of glasses. A part of the external perimeters of both washer portions 3A and
15 3B is joined with the joint 3C as shown with a chained line. The washers 3 are
doubled up at the center of the joint portion 3C and the elastic synthetic
resin ring 5 is interposed between the washer portions 3A and 3B.

On the location generally symmetrical to the external perimeter of
20 the joint portion 3C there are provided protrusion portions 7 and 8 which are
inwardly bent in confronting relationship with each other and are coincided with
each other. The bending angle of the protrusion portions 7 and 8 is determined
to be a degree of angle that at least the lateral sides of the apex of the
protrusion portions 7 and 8 coincide with each other and the mutual contact of
25 the protrusion portions 7 and 8 is not interfered at the time when the elastic
synthetic resin ring 5 is broken with compression. The protrusion portions 7 and
8 may be bent under the developed condition as shown with a chained line in FIG.
10 or may be bent with a tool, such as a plier, after the elastic synthetic
resin ring 5 has been inserted between both washer portions 3A and 3B. In
30 addition, in order to facilitate bending of the joint portion 3C which joins
both washer portions 3A and 3B and not to allow the joint portion 3C to be
resistant against compression given at the time of fastening, notches are
provided on both edges of the central part of the joint portion 3C, or weakened
portions may be provided on the joint portion 3C by forming thinned portions

1 thereon.

The protrusion portions 7 and 8 will do if they at least coincide with each other toward the fastening direction of the bolt 1 and the nut 2. As
5 shown in FIG. 11, however, when two protrusion portions 81 and 82 are formed perimetrically on one washer portion 3B, leaving a space between the protrusion portions so that the unitary protrusion portion 7 on the other washer portion 3A may come between both protrusion portions 81 and 82, the protrusion portions 7, 8 and 81, 82 coincide with each other whichever direction the bolt 1 and the
10 nut 2 rotate.

In another application of structure having a pair of washer portions 3A and 3B integrally assembled therein, it may be good to double up a pair of washer portions stamped out with a press die into the form of a pair of glasses,
15 insert an elastic synthetic resin ring between the said doubled-up washer portions, bend the protrusion portions provided on the location symmetrical (both edge portions of a piece of material in the form of a pair of glasses) to the joint portion on the external perimeter of each washer portion in confronting relationship with each other or bend the protrusion portions into
20 an L shape to butt both ends with each other or bend the protrusion portions into a Z shape to overlap the end surfaces of the protrusion portions, then braze, weld, or adhere the protrusion portions with an adhesive agent.

It may also be good to provide protrusion portions only on one washer
25 portion, bend the protrusion portions in confronting relationship with each other or into an L shape to butt the apex of the protrusion portions against the external perimeter edge of the other washer portion or bend the protrusion portions into a lateral U shape or a Z shape to overlap the end surfaces of the protrusion portions on the external perimeter edge of the other washer portion,
30 and then adhere the protrusion portions. It may further be advantageous to stamp out a pair of washer portions separately with a press die, lay the pair of washer portions on both surfaces of an elastic synthetic resin ring, provide protrusion portions bent into an L shape on the location diametrically symmetrical to the external perimeter edge of one washer portion, fit the

1 protrusion portions in holes or notches provided on the location responding to
the protrusion portions of the other washer portion, and then carry out brazing
and other similar processes. Still it may be good to lay two identical washer
5 portions, one having protrusion portions and the other having holes or notches
on the locations diametrically symmetrical to the external perimeter of each
washer portion, on the surface and the back of the elastic synthetic resin ring
in the phase being mutually deviated by 180 degrees, coincide the protrusion
portions with the holes or the notches on the other washer portion in
confronting relationship with each other, and then fit the protrusion portions
10 therein or adhere thereto.

For the elastic synthetic resin ring 5, it is simple and suitable to
form notched portions 5A on a plurality of locations of the external perimeter
of the ring 5, as shown in the illustration. In the illustration, the notched
15 portions 5A also serve to escape from the joint portion 3C and the engaging
protrusion portions 7 and 8 (81 and 82 for the illustration shown in FIG. 11).
In addition, since the size and shape of bolt through-holes on the washer
portions 3A and 3B have an effect on the compression value capable of breaking
the elastic synthetic resin ring 5, it would be better to take quality of
20 material, shape and thickness of the elastic synthetic resin ring 5 into
consideration.

To sum up, proper designing of the material quality, elasticity,
thickness and shape of the elastic synthetic resin ring 5 and the bearing
25 surface area adjacent to the washer portions 3A and 3B will determine the
destructive value for the elastic synthetic resin ring 5, that is, the fastening
force of the bolt 1 and the nut 2.

FIG. 13 shows a vertical sectional front view illustrating the
30 embodiment of the present invention prior to fastening. FIG. 12 shows the plane
figure of the embodiment, in which the bolt through-holes H1 and H2 of the
piled-up boards P1 and P2 are coincided with each other and the bolt 1 having
the elastic synthetic resin ring 5 with the washers 3A and 3B on both surfaces
is interposed between the bearing surface of the bolt 1 and one board P1, and

1 the nut is screwed on the bolt 1 through the washer 9.

As the nut 2 is increasingly fastened in the state as illustrated in FIGS. 12 and 13, the interposed portion of the elastic synthetic resin ring 5
5 between the washers 3A and 3B is compressed to be lengthened radially in inward and outward directions. When the fastening pressure of the bolt 1 and the nut 2 reaches the predetermined value, the elastic synthetic resin ring 5 is broken inwardly and outwardly on the compressed and lengthened portion, and the inwardly broken piece 5C (a ring shaped one) makes inroads into a gap between
10 the shank of the bolt 1 and the hole edge of the washer portions 3A and 3B. In this way, the washer portions 3A and 3B are closely adhered with each other.

Simultaneously, the interposed portion of the outwardly broken piece 5B between the washer portions 3A and 3B is pushed outwardly, and subsequently
15 the internal perimeter is lengthened to be torn off on the notched portions 5A. The torn-off outwardly broken piece 5B will be in a state of being hooked on the external perimeter of the washer portions 3A and 3B, or come off as indicated with the reference numeral 5B1. The hooked broken piece 5B can be removed with the fingers.

20

FIG. 16 is a front view illustrating an alternative embodiment of an elastic synthetic resin ring with washers on both surfaces. FIG. 17 shows the lateral view of that embodiment, in which the outside diameter of one washer portion 3B of the pair of washer portions 3A and 3B is formed to be larger than
25 that of the other washer portion 3A and roughly equal to that of the elastic synthetic resin ring. At least the inside surface of the washer portion 3B having a larger diameter, that is, the surface behind the elastic synthetic resin ring 5, is coated with a color distinctly different from that of the ring 5, such as blue.

30

The elastic synthetic resin ring 5 having the washers on both surfaces in the illustrative embodiment is fitted on the bolt so as to position the washer portion 3B having a larger diameter on the rear side, that is, so as to face washer portion 3B to be adjacent to the board P1, then fastened with the bolt 1. When the elastic synthetic resin ring 5 is torn off and removed

1 after the completion of fastening as shown in FIG. 18, then the external
perimeter of the washer portion 3B coated with a color different from that of
the elastic synthetic resin ring 5 and having a larger diameter will appear.

5 In the illustrative embodiment as mentioned above, the elastic
synthetic resin ring 5 having the washers on both surfaces has been interposed
under the bearing surface of the head portion of the bolt 1, while ring 5 may
be interposed under the bearing surface of the nut 2 or under both bearing
surfaces of the bolt 1 and the nut 2. Also, ring 5 may be interposed under the
10 bearing surface of the head portion of the pressure bolt (a tap bolt).

In summary, in the illustrative embodiment, when the screw components
which have the elastic synthetic resin ring having the washers on both surfaces
and being interposed under the bearing surface of the head portion of the screw
15 components are fastened, the interposed portion of the elastic synthetic resin
ring between the washers is compressed and lengthened radially in inward and
outward directions. When the fastening pressure reaches the predetermined
value, the elastic synthetic resin ring reaches the limit of elongation, and as
a result, the interposed portion of the elastic synthetic resin ring between the
20 two washers is broken inwardly and outwardly. Simultaneously, the two washers
adhere closely with each other.

The inwardly broken piece of the broken elastic synthetic resin ring
makes inroads into a gap between the shank of the screw components and the hole
25 edge of the washers to block the inlet portion of the gap. The outwardly broken
piece of the ring is pushed out at least of the outside washer portion. At the
same time the internal perimeter of the outwardly broken piece reaches the
limit of elongation and is torn off radially. The torn-off piece drops out of
the washers or becomes in a state of being hooked on the head portion of the
30 screw components or the washers. The torn-off piece can be removed with the
fingers.

Consequently, those places where the elastic synthetic resin ring
interposed under the bearing surface of the head portion of the screw

1 components has been broken and the outwardly broken piece has been removed from
the screw components or the outwardly broken piece has been hooked on the
external perimeter of the washers will indicate that fastening has been
completed. Visual confirmation of the completion of fastening is easily made,
5 since the external diameter of the elastic synthetic resin ring is larger than
those of the head portion of the screw components and the washers.

In addition, in the illustrative embodiment where the outside
diameter of one washer positioned on the rear side of the elastic synthetic
10 resin ring has been formed to be larger than that of the other washer on the
front side of the ring, the rear side washer appears. Thus, an indication of
the completion of fastening will be clearly made with exposure of the rear side
washer. Visual confirmation of the completion of fastening is easily made,
since the rear side washer is larger than the front side washer.

15

Those places where the elastic synthetic resin ring having the
washers on both surfaces and interposed under the bearing surface of the head
portion of the screw components has not been compressed or the elastic synthetic
resin ring has still been left inserted between the washers even after
20 compression will indicate negligence of fastening or insufficient fastening due
to temporary fastening.

It is needless to say that the illustrative embodiment shown in FIGS.
9 - 18 is also benefitted by other effects of the illustrative embodiment shown
25 in and described with reference to FIGS. 1 - 8. While the present invention
has been described with reference to the particular illustrative embodiments, it
is not to be restricted by those embodiments but only by the appended claims.
It is to be appreciated that those skilled in the art can change or modify the
embodiments without departing from the scope and spirit of the present
30 invention.

CLAIMS

1. Apparatus for indicating incomplete and complete fastening of screw components comprising:

a washer member (3) comprising a generally flat sheet of material which has a first opening (3D) of a size sufficient for receiving the shank of screw components (1, 2) and preventing said screw components (1, 2) from passing through the first opening; and

a ring member (5) comprising a generally flat synthetic resin sheet of material which has a second opening (5D) of a size sufficient for receiving the shank of screw components (1, 2) and preventing said screw components (1, 2) from passing through the second opening;

CHARACTERIZED IN THAT

said washer member (3) comprises:

a pair of washer portions (3A, 3B) each having a generally flat, round external shape whose outside diameter is at least equal to that of the head portion of the screw components (1, 2) and has a first opening (3D) formed almost on the center thereof; and

a joint portion (3C) for jointing the pair of washer portions (3A, 3B) in confronting relationship with each other so that the first openings (3D) on each of the pair of washer portions (3A, 3B) may equally receive the shank of the screw components (1, 2), said joint portion having a section substantially perpendicular to the axial extension of the shank of the screw components (1, 2), transforming into generally a U shape when the washer member (3) receives the shank;

said ring member (5) including a generally circular deformable material inserted between the pair of washer portions (3A, 3B), the generally circular material having an outside diameter larger than that of either of the pair of washer portions (3A, 3B);

said deformable material being lengthened radially when the first and second openings (3D, 5D) receive the shank of the screw components (1, 2) and the deformable material is compressed by the pair of washer portions (3A, 3B) due to fastening of said screw components (1, 2), said deformable material being broken due to overlapping of the pair of washer

portions (3A, 3B) when compression force reaches almost a predetermined value.

1 2. Apparatus in accordance with claim 1 CHARACTERIZED IN THAT said
deformable material is an elastic body, and the size and shape of the first
opening (3D) and the elasticity of the deformable material have been selected so
that the deformable material can be broken when compression force reaches the
5 predetermined value.

1 3. Apparatus in accordance with claim 1 CHARACTERIZED IN THAT said
ring member (5) has a plurality of cuts (5A) formed on the perimeter of the
generally circular material radially in an outward direction.

1 4. Apparatus in accordance with claim 3 CHARACTERIZED IN THAT the
cuts (5A) provided on said ring member (5) have been formed so that the depth
of the cuts (5A) in a radial direction of the circular material may at least
reach the perimeter of either of the pair of washer portions (3A, 3B).

1 5. Apparatus in accordance with claim 1,
CHARACTERIZED IN THAT
said joint portion (3C) protrudes radially in an outward direction
beyond the pair of washer portions (3A, 3B),

5 said apparatus further comprising an indicator member (4) supported
by said joint portion (3C).

1 6. Apparatus in accordance with claim 1 CHARACTERIZED IN THAT said
pair of washer portions (3A, 3B) have diameters different from each other, said
ring member (5) having an outside diameter substantially larger than that of one
(3A) of the pair of washer portions (3A, 3B) which has a smaller outside
5 diameter.

1 7. Apparatus in accordance with claim 6 CHARACTERIZED IN THAT said
ring member (5) has an outside diameter substantially equal to that of one (3B)
of the pair of washer portions (3A, 3B) which has a larger outside diameter.

1 8. Apparatus in accordance with claim 6 CHARACTERIZED IN THAT one washer portion (3B) having a larger outside diameter has a colored surface confronting with the other washer portion (3A).

1 9. Apparatus in accordance with claim 8 CHARACTERIZED IN THAT said ring member (5) has a color distinctly different from the colored surface of said one washer portion (3B).

1 10. Apparatus in accordance with claim 1,
CHARACTERIZED IN THAT

at least one of the pair of washer portions (3A, 3B) includes engaging means (7, 8, 81, 82) provided on a position generally symmetrical to
5 said joint portion (3C) with respect to the center of a circle thereof,

said engaging means (7, 8, 81, 82) being interdigitated with the other washer portion to prevent both washer portions (3A, 3B) from co-rotating in the direction of the outermost perimeter of the circles thereof with the rotation of the screw components (1, 2).

1 11. Apparatus in accordance with claim 10 CHARACTERIZED IN THAT said engaging means (7, 8, 81, 82) comprise a plurality of protrusion portions (7, 8) formed on each of the pair of washer portions (3A, 3B) and interdigitated with each other.

1 12. Apparatus in accordance with claim 11 CHARACTERIZED IN THAT said engaging means (7, 8, 81, 82) include:

a first protrusion portion (7) formed on one (3A) of the pair of washers portions; and

5 a pair of second protrusion portions (81, 82) formed on the other (3B) of the pair of washer portions isolatedly with each other;

the first protrusion portion (7) being interposed in a space between the second protrusion portions (81, 82) and engaged with the second protrusion portions (81, 82).

10 13. Apparatus substantially as described with reference to and as shown in the accompanying drawings.

THIS PAGE BLANK (USPTO)

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☒ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☒ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☒ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☒ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☒ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.

THIS PAGE BLANK (USPTO)